

# TECHNOLOGIES DEVELOPED BY INDIAN INSTITUTE OF SUGARCANE RESEARCH (IISR), LUCKNOW

## 1. Tractor Operated Multipurpose Equipment



**Fig: Three row multipurpose equipment in various modes of operation**

**Description:** This is a tractor-mounted equipment, which is mounted with three point linkage system. This can be lifted or lowered by the hydraulic system of the tractor. This equipment can perform following operations.

**Land Preparation:** The equipment can be used as tractor operated nine tine cultivator.

**Cane Planting:** The equipment can be used as whole cane cutter planter for planting of sugarcane in three row simultaneously. Planting includes opening of furrows, cutting cane setts and placing of setts in furrow, placement of fertilizer and chemicals, covering the setts with soil and providing light compaction.

**Interculture:** The equipment can be used for inter-cultural operation in sugarcane field. Three inter row spaces are intercultured in single pass. There will be 2-3 tines in each inter row, as per requirement.

**Earthing-up:** Earthing-up operation in three row of cane can be performed by this equipment.

All above operations required for sugarcane culture may be performed by IISR Tractor Drawn Multipurpose Equipment with minor changes/adjustment. The same can be carried out at farm with the help of simple tools.

**Puddling :** A rotary beater type sub-unit may be mounted with the main frame of the equipment for puddling of field for paddy transplanting.

**Drilling of Seeds :** The fertilizer box may be used as seed box. Main frame, power transmission system and ground wheels of the equipment remains as such. Only a sub-unit for opening the rows is to be mounted. This can meter (through fluted rollers) and drill seeds in 10 rows having spacing of 22 cm. Row spacing may be varied also.

## 2. IISR Tractor operated improved two row sugarcane cutter planter



**Fig : Improved two row sugarcane cutter planter in operation**

**Description:** The planter can be operated by any tractor of 25 hp or above. It is a mounted type. It can plant sugarcane in two rows simultaneously.

**Furrow opening** : Two way mould board shaped furrow have been used to open furrows. Arrangement has been made to vary the depth of furrows.

**Sett cutting** : The cutting unit takes full cane of any shape and size. It cuts setts of 37cm long. Length of setts remain same up to tractor speed of 3 km/hr. The operator has to lift the cane from seed tray and place it in the slanting chute (55° w.r.t. horizontal plane). Cane slides down to cutting unit(s) through gravitational force. Hence operator finds enough time for setts cane feeding. This minimises gaps in setts placement in furrows. The cane are cut at an angle of 65° by curved rotating blades. Thus cutting becomes very smooth and clean.

**Fertilizer Application:** Fertilizer is metered through fluted rollers and placed near the setts in the furrows.

**Liquid chemical Dispensing** : As per requirement, liquid chemicals can be dispensed over the setts in the furrows. A PVC pipe of 15 cm diameter has been provided to store the chemical. Its capacity is 25 lit. Two brass nozzles with stop cocks are fitted in this pipe to dispense chemicals on setts in both the furrows. Instead of tanks/ containers, PVC pipe has been used to avoid rusting and minimise variation in chemical application rate.

**Soil covering** : Setts in furrows are covered with loose soil. A tamping roller presses the furrow soil lightly to conserve soil moisture.

**Miscellaneous** : It is the lightest and most compact planter available in the country, probably in the world. Its power transmission system is very simple. Hence chances of break downs are minimum. Ground wheels are such designed and placed that clodding and slippage will be minimum. Best efforts have been made to shift the weight of the machine nearest to tractor so that any tractor of 25 hp would be able to pull/ lift it.

### 3. IISR Tractor drawn Cutter Planter cum Seeder



**IISR Sugarcane Cutter Planter cum Wheat Seeder**

The technology is recommended for wheat-based sugarcane farming system. The equipment is basically a sugarcane cutter planter with attachment for sowing wheat. It has been provided with special devices for planting sugarcane and sowing wheat in a single pass of the tractor. Sugarcane is grown along with wheat with no extra energy and crop-inputs while yield of both crops are at par with the normal solo crops. Sugarcane requires crop-inputs only after harvesting wheat crop. It does not

suffer with problems associated with planting sugarcane in succession after harvesting wheat crop. The seeder- cutter/planter is equipped with following units:

**Tine type furrow opening:** Tines are used to tear open a slit. Furrow widener and guider help placing cane- setts in slit in an orderly manner at proper depth. Shoe type openers are used to sow wheat.

**Sett cutting :** The cutting unit takes full cane of any shape and size. It cuts setts of 35-37 cm long and guides about 31 setts to each 10 m length of furrow. Sett cutting unit is driven through a ground wheel.

**Seed metering:** It is equipped with fluted feed type seed metering mechanism. The metering shaft is powered through the ground wheel of the cutter planter.

**Dispensing :**Fertilizer is dispensed through a metering unit. Liquid chemical is applied through gravity in furrows.

**Soil covering:** Setts and wheat seed are covered with loose soil with the help of two 93.0 cm long and 10.0 cm diameter rollers. These rollers are filled with sand to provide light compaction to the furrow soil.

<b>Technical Data: (Sugarcane / Wheat)</b>	
Type of furrow opener	Tine / Shoe type
No. of furrow openers	2 / 10
Width of the furrow, cm	10 / 5
Row to row distance, cm	75 / 22
Equipment derives power through	Ground wheel
Field capacity, ha/h	0.25
Field efficiency, %	65 – 70
Saving over conventional planting, %>	40
Price, Rs.	32,500
<b>Specifications:</b>	
Length, cm	168
Width, cm	187
Height, cm	80
Weight, kg, approx	250

#### 4. IISR Tractor drawn sugarcane cutter planters



**IISR Disc Type Cutter Planter**



**IISR Slit Type Cutter Planter**

#### **Description**

**Furrow Opening:** Two discs (one for each furrow) are arranged to open furrows in almost all types and conditions of soil. Furrow guiders assist in proper placement of cane setts in the furrow.

**Ridger type:** Ridgers are used for opening furrows in well-tilled soil.

**Slit type:** Tines are used to tear open a slit. Furrow widener and guider help placing cane- setts in slit in an orderly manner at proper depth.

**Sett cutting:** The cutting unit takes full cane of any shape and size. It cuts setts of 35-37 cm long and guides about 31 setts to each 10 m length of furrow. It is driven through tractor PTO in the ridger type, through one ground wheel in the disc/slit type cutter planter.

**Dispensing:** Fertilizer is dispensed through a metering unit. Liquid chemical is applied through gravity in furrows.

**Soil covering:** Setts in furrows are covered with loose soil. Tamping roller presses the furrow soil lightly to conserve soil moisture.

**Miscellaneous:** It is equipped with comfortable seats and appropriate boxes for storing sugarcane, fertilizer, and liquid chemical.

#### 5. IISR Moist hot air seed cane treatment unit

The MHAT unit has been designed to control seed piece transmissible diseases like grassy shoot, ratoon shunting and primary infection of red rot of sugarcane, which otherwise pass from one generation to another. It also helps controlling the insect, pests like scale, mealy bugs etc.

## Working details

Seed cane is treated above 95% humidity at  $54 \pm 1/2^\circ$  C for a total duration of 4 hours including initial period of heating

The unit consists of

- a thermally insulated chamber
- a cylindrical drum with wire mesh tray 8-10 numbers, 1 kw finned air electric heater
- a 60 cm sweep blower fan steam generating unit
- and instruments for precise control of temperature and humidity



**Inside View of MHAT Unit**

Sugarcane is loaded in the trays, which are kept inside the drum. Doors are closed for a set duration of time. Steam is generated outside the rear panel and is injected inside the chamber. It gradually gets mixed with hot air. Most hot air circulates inside the drum to treat seed cane.

**The heat treatment has become a major component of seed programme in India and abroad. The unit has been released for commercial production.**

## 6. Bottled Sugarcane Juice Concentrate

Sugarcane juice concentrate is an intermediate product obtained while concentration of the sugarcane juice after purification for jaggery making. This product is collected in semi-liquid form from the boiling pan and packed in suitable containers for marketing. The quality of the concentrate depends on cane variety and the composition of the juice, type of the clarificant used and the striking temperature at which the liquid jaggery is collected. The product is utilized as a sweetening agent in foods and drinks in many parts of the country, viz., Maharashtra, Gujarat, Kerala, Andhra Pradesh, Tamil Nadu, etc.

## **Protocol for preparation of the cane juice concentrate**

The step involved in preparation of the cane juice concentrate begins from the harvesting of cane. The cane should be crushed within 24 hrs after harvesting to avoid deterioration due to inversion. The cane juice after extraction is filtered through a muslin cloth and collected in an storage tank. The juice is poured in an open pan and is heated to facilitate the coagulation of the suspended particles into gummy colloidal substance. When the temperature reaches 85°C, which takes around 115-120 minutes, the nitrogenous impurities present in the juice start coagulating and floating on the surface, which are removed using the hand laddle.

At this stage, the clarificant (preferably vegetative) is added. After addition of the clarificant, a golden coloured substance called scum appears on the surface, which once again was removed. After complete clarification, the boiled juice becomes clear, transparent and light brownish yellow in colour. Later on, the juice is concentrated. At 99-100°C, the juice begins to froth.

In order to avoid this frothing and charring continuous stirring is done and at the striking temperature of 108°C the juice becomes viscous and is removed from the heating source. The concentrate is cooled and citric acid + benzoic acid (0.05% + 0.5%) are added as preservatives. The product can be flavoured using the essence of orange, rose, etc. to give it a distinct flavour This concentrate is cooled in large settling tanks and is packed and sterilized.. The product finally resembles honey in appearance. The concentrate can be stored for a year without any deterioration in its quality.

### **7. Ready-to-use Juice Clarificant Powder prepared from Deola *Hibiscus ficulneus*) Stem for Making Jaggery (Gur)**

In Jaggery manufacturing sodium hydrosulphite (hydros) is indiscriminately used for juice clarification beyond recommended limits (35 g hydros/1000 l Juice) for clarification of cane juice to impart light golden yellow colour to jaggery. Often level of SO<sub>2</sub> in jaggery exceeds beyond 50 ppm which is not suitable for human consumption (Bureau of Indian Standard I.S.12923, 1990). Many phyto-clarificants have been reported during the last 60 years. Amongst the phyto-clarificants fresh deola stem was found to be quite effective juice clarificant for jaggery making. Since deola plant is not available during peak period of jaggery manufacturing, there is a need to develop some phyto-clarificants as ready to use form for supply during the period of jaggery manufacturing. Keeping this in view, a ready-to-use clarificant powder has been prepared from deola stem.

#### **Preparation of ready to use vegetative clarificant powder**

The clarificant powder is prepared from the shade dried deola stems collected at seed formation and maturity stages of growth of the plant. Deola stem is thoroughly washed with tap water. After drying stem and branches are separated out and then scrapped by using motorized cane preparator. The scrapped sample material is kept for drying under shade. The dried stem is subjected to grinding for preparation of powder. After grinding, powder (< 1 mm light yellowish and greenish brown coloured particles) is sieved out from fibrous stem material. Powder thus obtained is kept in bottle/packed in polyethylene.

**Method of Use:** 25 g Deola stem powder is suspended in 2 liter water and mixed thoroughly. After 1 hour mucilaginous extract is filtered. Mucilaginous filtrate is used for clarification of 100 liter of cane juice.

The quality of jaggery prepared from cane juice using ready to use deola stem powder (25 g/100 l juice) is similar to the jaggery prepared using fresh deola stem (aqueous extract of 40 g stem/100 litre juice). Clarificant powder prepared from shade dried stem of deola plant harvested at seed formation and maturity stages can be used in place of the most commonly used hazardous chemical clarificant such as sodium hydrosulphite.

### 8. Solid Jaggery in uniform shape and size



#### **Brick shaped Jaggery and Jaggery Cubes**

The diversity in shape of single commodity does not attract any one for the development of equipment/gadgets for the product handling. therefore, for uniformity of shape and size jaggery molding frames were developed at IISR, Lucknow to manufacture brick shaped jaggery weighing 125, 250 and 500 g and 2.5 cm cube weighing about 20 g. The juice extracted through mechanical crushers is boiled, clarified and concentrated. Concentrated semi-solid mass after puddling in cooling pan, is poured into these frames and leveled up with laddle. After about 40-45 minutes when the jaggery is set, brick and cubes are removed by dismantling the frame. The frames are reused after assembling.



#### **Gur Molding Frame**



*The specifications of the moulding frames are as given below :*

Name of the Equipment	JAGGERY MOULDING FRAME	
Suitable for	Moulding the jaggery	
Type	Batch type	
<b>Specifications</b>		
Length (mm)	620	860
Width (mm)	590	720
Height (mm)	25	25
Cube size (mm)	25x25x25	-
Brick size (mm)	-	75x52x25
Jaggery Cube (g)	20	-
Jaggery brick (g)	-	125
Capacity (kg/h)	9.33	20
(kg/batch)	7	15
Power source	Manual	
Labour requirement (m-h/batch)	2.0	
Cost of equipment (Rs.)		
Capacity 7 kg/batch	4000	
Capacity 15 kg/batch	6000	

### 9. Manufacturing of Granular Jaggery



### *Granular Jaggery*

The fresh juice with raised pH of 6 to 6.2 by adding lime as clarificant is heated in the open pan. After attaining the striking point temperature of 120-122° C the hot mass in the pan is removed from furnace and allowed to cool with thorough mixing for few minutes. The thickened mass is transferred from pan to the alluminium trays or on cement platform and allowed for cooling for few minutes without stirring for good crystal formation. The process flow chart is shown in Fig. 4 At the time of solidification the mass is made into powder manually using wooden scrapers without any lapse of time. Prepared powder is then sun dried from about 11.50% to 1.5% moisture content, sieved through 1-3 mm sieves and packed in 400 gauge polyethelene sachets or PET Bottles. The granular jaggery (Fig. 5) weighing 100 g contains 80-90 g sucrose, 5-6 g reducing sugar, 0.4 g protein, 0.1 g fat, 9 mg calcium, 4 mg phosphorus, 12 mg iron, 0.6-1.0 g total minerals and 385 kcal energy. It is convenient for handling, drying, packaging, storage, transport and distribution. It has about 2 years safe storage like.

Considering various cost factors and assumptions almost similar to the liquid jaggery (except for recovery of about 10%) for a plant capacity of 70 q cane/day, the cost of production for one kg of granular jaggery would work out to be about Rs.12.

### **10. Improved IISR Furnace**



#### ***Double pan IISR Furnace***

Double pan IISR Furnace was improved by providing special features viz. step grate for consumption of fuel, gutter pan for preheating of juice for next charge, chimney for sufficient draft and provisions for preheating of air. Striking temperature is achieved after about 2.75 hours of operation in first lot whereas second lot reaches striking point after two hours. Major saving is due to preheated gutter pan juice. Also the introduction of forced draft system saved 9% bagasse consumption as compared to the natural draft. The cost of juice concentration and jaggery making worked out to be Rs. 17.50 and 12 per quintal, respectively, with the furnace price of about Rs. 15000/-.

**Source:** [Indian Institute of Sugarcane Research \(http://www.iisr.nic.in/\)](http://www.iisr.nic.in/)